

10/551,364

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Amendments to the Specification:

In the Specification, please amend the following paragraphs as set forth below. Applicant notes that the paragraph numbers used herein are from the published application, and in some cases differ from those of the specification as filed – particularly that paragraph [102] of the filed application is paragraph 0093 of the published application.

[0015] Another object of the present invention is to provide a method of producing a bio-diesel oil in a great amount in a relatively short time, in which a portion of fatty acid alkyl ester (hereinafter, referred to as 'alkyl ester') as a product is ~~refluxed~~ recycled to reactants during a transesterification reaction of an oil/fat with alcohol to act as a subsidiary solvent to quickly convert the reactants immiscible with each other into a single phase mixture, thereby promoting the reaction of the oil/fat and alcohol.

[0019] According to the second aspect of the present invention, there is provided a method of producing the bio-diesel oil, in which alkyl ester is added to a mixture of the oil/fat and alcohol by ~~refluxing~~ recycling alkyl ester as a product to the mixture.

[0030] In addition, a portion of the product comprising the alkyl ester of the step (a) or/and the produced by step (b) is directly recycled to the reaction mixture of step (a) and/or step (b) prior to separating the alkyl ester and glycerine in a separator added to the reactants by refluxing alkyl ester as the product to the reactants.

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[0056] In this regard, commercial alkyl ester may be added to the reactants, or a portion of alkyl ester produced according to the following Reaction equation 1 may be

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refluxed recycled to the reactants. The latter is more preferable than the former in consideration of the costs of the reactants.

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[0075] FIG. 2 illustrates a process of producing the bio-diesel oil according to the second aspect of the present invention. Unlike the case of FIG. 1, a portion of alkyl ester is refluxed recycled from a second storage tank 5 into a second mixer 2 in FIG. 2. Accordingly, it is not necessary to separately feed alkyl ester into the second mixer 2.

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[0076] The process as shown in FIG. 2 is very usefully applied to a continuous reaction process using the PFR or CSTR. Additionally, alkyl ester is separately fed from an external feeding source to the reactants in only an early stage of the reaction, and then automatically and continuously refluxed recycled to the reactants in a required amount, preferably in the amount of 1 to 30% based on the weight of the oil/fat.

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[0079] After the completion of the transesterification of the oil/fat with alcohol, the catalyst is recovered from the product. In detail, in the case of using the homogeneous catalyst, the resulting product is washed with water to recover the homogeneous catalyst therefrom. On the other hand, in the case of using the heterogeneous solid catalyst, most of the solid catalyst remains in the reactor without a separation process. A small amount of the solid catalyst discharged from the reactor is recovered from the product using a settler or a centrifugal separator. When a mixture of glycerine and alkyl ester produced through the transesterification reaction is left for a predetermined time after the recovery of the catalyst, a boundary layer is formed between glycerine and alkyl ester. At this time, alkyl ester is provided on the boundary layer and glycerine is provided beneath the boundary layer, thereby glycerine and alkyl ester are separated from each other. As described above, after the separation of alkyl ester from glycerine, a portion of alkyl ester

may be ~~refluxed~~ recycled into the reactants. The resulting alkyl ester may contain a little alcohol. In this respect, the resulting alkyl ester may be subjected to a distillation process to remove alcohol therefrom in order to produce highly pure alkyl ester.

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[0095] At this time, a portion of alkyl ester is preferably ~~refluxed~~ recycled from the storage tank 16 to the mixer 13 and the reactor 11, therefore it is feasible to avoid the cumbersome problem that alkyl ester is fed from an external feeding source into the mixer 13 and the reactor 11.

¹⁵²
[0137] Meanwhile, when alkyl ester acting as the product is ~~refluxed~~ recycled to the reactants after the reaction of oil/fat with alcohol, a relatively high reaction rate is continuously maintained to improve the productivity and yield of the bio-diesel oil.